


ILLINOIS STATE GEOLOGICAL SURVEY



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STATE GEOLOGICAL SURVEY
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ABSTRACTS OF PAPERS DEALING WITH
CLAY AND CLAY PRODUCTS

Presented at the

THIRD ANNUAL MINERAL INDUSTRIES CONFERENCE
OF ILLINOIS
May, 17-18, 1935

Illinois' Position as the Keystone Mineral State of the Upper Mississippi Valley - M. M. Leighton.

Technologic Trends in the Production and Utilization of Clay and Clay Products - Fred L. Steinhoff.

Viewpoint of Science Regarding the Production and Utilization of Nonmetallic Minerals - C. W. Parmelee and J. E. Lamar.

Chemical Engineering Problems Relating to the Mineral Resources of the State - D. B. Keyes.

Trends in the Development and Use of New Units and Materials for Building Construction - F. M. Lescher.

Reinforced Brick Masonry for Permanence - Hugo Filippi.

Brick Houses - Cheaper and Better - A. W. Luse.

Recent Findings on the Relation of the Constitution of Clays and Shales to their Ceramic Properties - Ralph E. Grim.

Report of Progress on the Study of Illinois Face Brick - C. W. Parmelee.

Report of Progress on the Study of Light Weight Aggregates - C. W. Parmelee.

August, 1935

INTRODUCTORY NOTE

The Third Annual Mineral Industries Conference of Illinois sponsored by the Illinois State Geological Survey and the Engineering Experiment Station of the University of Illinois, held at Urbana on May 17 and 18, had as its theme, "Trends in the Utilization of Mineral Products". The conference gave particular attention to the clay and clay products industry, and many points of interest to this industry were brought out in the various papers and the discussions which followed them. In order that interested individuals who could not arrange to attend the meetings may know of these points, these abstracts have been prepared, giving attention only to that part of the Conference devoted to clays and clay products. It is hoped that arrangements can be made whereby the complete papers can be published. The Survey does not assume responsibility for the statements here presented.

GENERAL SESSION

The Conference met in general session the first half day to consider the subject, "Trends in the Utilization of Mineral Products", from a broad viewpoint. The first paper, given by Dr. M. M. Leighton, Chief of the Illinois State Geological Survey, was entitled, "Illinois' Position as the Keystone Mineral State of the Upper Mississippi Valley". He pointed out that Illinois, with its resources of fuel, clay, shale, building stone, limestone, sand, gravel, fluorspar, etc., has always been a leading mineral producer. By pointing out two facts, first that our modern civilization and its high standards of living demand minerals and therefore the use of minerals will continue, and second that science has developed so rapidly in recent years that the utilization of minerals has undergone rapid change, Dr. Leighton was able to emphasize the absolute necessity that individuals active in industry keep in close touch with modern scientific research on mineral products in order to keep abreast of developments and thereby protect their investments. These factors led him to emphasize the way in which scientific research on Illinois raw material is tending to extend their use by developing new products or improving old ones. Specific examples were given. By means of such research, the leading position of Illinois as a mineral producing state should be retained.

Under the heading, "Technologic Trends in the Production and Utilization of Clay and Clay Products", Mr. Fred L. Steinhoff, Editor of Brick and Clay Record, indicated recent developments in the ceramic industry under the headings: New equipment and processes, new products, and new equipment. Under new equipment were discussed the application of de-airing, the use of magnetic separators to remove detrimental constituents such as pyrite and mica, preheating

clays to lower the sulfur content, and the use of facing machines to increase the range of colors and textures in low grade clays. Among the new products noted were finely ground waste clay from the dryer used to supplant up to 25 per cent of the mortar in cement and commonly known as "mortar mix", sewage filter rings said to be more efficient than the commonly used crushed quartzite, so-called light weight products used for insulating purposes or for structural purposes where light load is essential, multicored brick containing as many as 60 small holes to reduce weight, 2-inch brick veneer for the more economical veneering of old homes, double brick in the form of hollow units taking the place of two bricks, thereby saving labor laying cost, and flagstone and ashlar block products made to resemble natural slate and ashlar stone respectively. The development of reinforced brick masonry, the resurfacing of old roads with brick, the increased use of glazed or enameled brick, and the increased use of clay products for interior decoration were mentioned as new uses for old products. For the industry as a whole, Mr. Steinhoff forecast a distinct forward movement in processing control and an absorption of technically trained men who can man this control processing equipment.

In their paper on "The Viewpoint of Science Regarding the Production and Utilization of Nonmetallic Minerals", Prof. C. W. Parmelee, Head of the Department of Ceramic Engineering of the University of Illinois, and Mr. J. E. Lamar, Geologist and Head of the Non-Fuels Division of the State Geological Survey, pointed out that the future of the nonmetallic mineral industry of Illinois will witness the continuance of many of the existing uses for these minerals in their raw state and as manufactured products and that there will be a continuous development of new products and uses, with an increasing emphasis on the production of raw materials or products having definite physical, chemical, and mineralogical characteristics, and a gradual tightening of specifications. This requires that science provide data on the location and physical aspects of the State's present and potential non-metallic resources, on the detailed chemical, physical, ceramic, and mineralogic properties of these materials, and the relation of all these properties to utilization so that new products may be developed and old ones improved. The paper noted how these requirements are being met by current researches of the Illinois State Geological Survey and the Ceramic Engineering Department of the University of Illinois into the constitution of the State's clays and shales and the relation of constitution to properties determining utilization.

A paper was presented by Professor D. B. Keyes, Head of the Chemical Engineering Division of the University of Illinois, entitled, "Chemical Engineering Problems Relating to the Mineral Resources of the State", in which were discussed investigations which should lead to the greater utilization of these resources. Coal, petroleum, stone and silica were considered.

Among important coal problems are the removal of slag and sulfur, with the recovery of sulfur in utilizable form, and the use of by-products as raw materials for organic syntheses.

Petroleum problems discussed include improving recovery from wells and the use of petroleum as raw material for organic syntheses.

The possibility of manufacturing synthetic stone in Illinois was noted.

Finally, it was pointed out that silica could be converted to an aerogel, which is both an insulating material and a catalyst.

EXHIBITS AND DEMONSTRATIONS

"Demonstration of Clay Research", R. E. Grim, Petrographer, State Geological Survey. The demonstrations concerning clays and clay products illustrated the technique whereby these materials are literally taken apart by the supercentrifuge and then analyzed microscopically, chemically, and by means of the X-ray to obtain a complete picture of their mineral composition. The means whereby the petrographic microscope permits a further analysis of the texture of clays, shales, and burned ceramic products was shown. A series of burned test pieces were displayed to demonstrate the plan used to investigate the relation between mineral composition and ceramic properties.

"Exhibit of Light Weight Brick", C. W. Parmelee, Head of the Department of Ceramic Engineering, University of Illinois. The exhibit included several specimens of full size brick made from mixtures in varying proportions of till from Cook County and peat, and of fireclay from Ottawa and peat. These exhibits of material which had been burned to cone 01 demonstrated that products of high absorption (approximately 50%) and very low bulk density (about 0.98%) could be prepared which were mechanically strong and had a good appearance.

"Exhibit of Novaculite Refractories", C. W. Parmelee, Head of the Department of Ceramic Engineering, University of Illinois. The exhibit of the researches on the use of southern Illinois novaculite included a large number of small fired specimens which had been prepared with the use of various bonding agents and accelerators. An important phase of the study of this problem had been the proper sizing of the crushed material. These specimens demonstrated that with a proper sizing of grain and choice of the bonding agent, excellent results could be obtained since the appearance and the compressive strength equalled that of commercial silica brick. A few specimens of standard size novaculite brick prepared in a similar manner were exhibited.

EVENING ADDRESS

One of the high points of the meetings was the address by Dr. John W. Finch, Director of the U. S. Bureau of Mines, which followed the annual Conference dinner. Dr. Finch pointed out that minerals are more necessary to the life and well-being of people than most persons realize. Not only are minerals necessary for progress and for comfortable human existence, but mining carries a large burden of responsibility for the welfare of the community. He said that the chief causes of trouble in the mineral industry today, over-production and unemployment, have their seeds in the World War and not in the depression. The period of inflation and over-production following the war necessitated a period of readjustment that has not been accomplished yet. According to Dr. Finch, the committee appointed by the President to study causes of maladjustment and unemployment in the industry and to recommend means of improvement, had recommended that the government allow the various groups in the industry to attempt to work out their own affairs, and that all other expedients would be tried before that of government control.

SYMPOSIUM ON CLAY AND CLAY PRODUCTS

The second day of the Conference was given over to a series of symposia, one of which directed its attention, under the chairmanship of Mr. E. F. Plumb, President of the Streater Brick Company, to Illinois clays and clay products. The first paper in this symposium by Professor F. M. Lescher of the Department of Architecture of the University of Illinois discussed "Trends in the Development and the Use of New Units and Materials for Building Construction". Professor Lescher discussed the greater utilization of larger factory-prepared or prefabricated units in house construction as a means of increasing durability and reducing costs, thereby making bricks more available for construction in modest priced houses. He noted the possibility of using terra cotta face units to give increased diversity and beauty to the outside of pre-cast slabs without increasing their cost. The developments attained and pending in the manufacture of stronger, more elastic, and more heat-resisting glass open vast possibilities for the use of this material for construction. Moulding, etching, engraving, and sand blasting of glass offer many varieties of surfaces for interior decoration. Among other trends in building materials were noted the possible development of a wall unit with insulating ability by packing hollow tile with rock wool, and the use of enameled steel units for interior and exterior purposes. Following an analysis of the problem of low cost housing, Professor Lescher dissented from the idea that there will be a trend toward the mass production of houses on the plan of modern automobile production.

Mr. Hugo Filippi, General Superintendent of the Illinois Brick Company, in a paper, "Reinforced Brick Masonry for

Permanence", showed how reinforced brick masonry combines the high compressive strength of ordinary brickwork with the high tensile strength of steel, eliminating the inherent weakness of plain brick work in tension. Brick construction is now possible carrying heavy loads in flexure and in shear. Scientific research during the past ten years has established the fact that the principles of design for reinforced brick masonry and reinforced concrete are the same and the same design formulas may be used. Of particular interest is the use of this type of construction in pre-built slabs and for constructing "earthquake proof" residences in the California earthquake area. The great strength of this type of construction was illustrated by showing a motion picture of the wrecking of the Brick Manufacturers' Association house at the Century of Progress. The great difficulty in wrecking this house and the fact that many large portions of the masonry in the house retained their shape and size on wrecking were convincing evidence of the permanence of this type of construction. The motion picture showed the results of a fire started in the house previous to wrecking which indicated that reinforced brick masonry is amply fire resistant.

Mr. A. W. Luse, Secretary-Manager of the Chicago Face Brick Bureau, in his paper, "Brick Houses - Cheaper and Better", described the "Country Home" Magazine's Model Farm House at the 1934 Century of Progress, the first to be so constructed. This eleven room, two-story face brick house, architecturally designed for three basic factors - low cost, low upkeep, and to be practically fireproof - can be built for \$5,000 where skilled labor is not more than \$1.00 per hour. This includes plumbing, heating, and lighting fixtures. Single, 4-inch thick, load-bearing, reinforced brick masonry panels with IPan ferro concrete floors were used in constructing the house. No wet plaster was used in the house; various wall coverings - wall boards, linoleum, etc. - were used for coverings. The low cost of construction of this type of home comes partially from the fact that one entire course of back-up brick is eliminated, saving material and labor costs. Mr. Luse described in detail, and illustrated with slides, the procedure used in the erection of a home of this kind. He showed that it needs no factory fabrication, is not dependent in any way upon mass production, utilizes local labor and local material, the architect has full latitude in design for individuality in every home, and the house is rust-, termite-, and fire-proof. It can have a pitched or a deck roof, or a combination of both. The house is of monolithic construction, and its type of construction has been approved by the Federal Housing Administration for insured loans. It represents an example of the brick industry's ability to provide homes suitable in all requirements for modern low cost housing.

The paper by Dr. R. E. Grim, Petrographer of the Illinois State Geological Survey, entitled "Recent Findings on the Relation of the Constitution of Clays and Shales to

Their Ceramic Properties", was a progress report of the Survey's research into the fundamental factors of constitution which control the ceramic properties of Illinois clays and shales. This research is leading to the accumulation of a body of information on Illinois materials which should be of value in improving present products, in solving certain processing problems, and in developing new products.

A series of curves for a group of Pennsylvanian shales were presented which illustrated the way in which their values for modulus of rupture, drying shrinkage, and burning shrinkage tended to decrease as their coarseness in grain increased. Shales possessing ceramic values above or below the average for shales of similar degree of coarseness were shown to possess distinctive textural characteristics such as slight silicification.

A second series of curves were presented to indicate the relative influence different mineral constituents exert on the ceramic properties of the State's shales and underclays. By devising a means to take into consideration variations in grain size and texture, the tendency of the mineral kaolinite (contained by the underclays but not by the shales) to increase modulus of rupture and drying shrinkage and to reduce burning shrinkage could be analyzed. Likewise, the opposite influence of the sericite-like constituent essential to the shales could be analyzed.

Recent research has shown that plasticity, drying shrinkage, and perhaps other green properties, are influenced in a given clay by the ability of that clay to possess exchangeable bases, and by the identity of the exchangeable bases present. Thus, it was shown that a clay possessing exchangeable sodium will have its plasticity increased and its shrinkage reduced by the substitution of calcium for the sodium. A consideration of other factors of importance in the relationship between base-exchange and ceramic properties was presented.

In his paper, "Report of Progress in the Study of Illinois Face Brick", Professor C. W. Parmelee, Head of the Department of Ceramic Engineering, University of Illinois, reported some results of a comparative investigation of the physical properties of 22 brands of Illinois face brick and 11 competing brands of brick from out of the State. Many data were presented concerning the uniformity of size, warpage, compressive strength, transverse strength, absorption, permeability, density, hardness, content of soluble salts, and color of these bricks, which indicate an apparent superiority of Illinois brick in all of these physical properties. These data will make available a catalogue of the physical properties of most of the standard brands of face brick manufactured in the State.

Professor Parmelee followed this report by a second paper entitled, "A Progress Report on the Study of Light Weight Aggregates". He presented the results to date of a joint in-

vestigation by the Illinois State Geological Survey and the Department of Ceramic Engineering of the University of Illinois, into the possibilities of producing a highly porous brick suitable for insulation purposes by the introduction of varying amounts of Illinois peat into brick produced from typical Illinois fireclay, shale, and surface clay. Test pieces containing varying amounts of peat were burned at different temperatures. Using the experience gained with the small test pieces, full sized bricks were made and burned to cone 01. In the case of surface clay brick (glacial till) the original absorption of 10.7% and apparent specific gravity of 1.70 were changed by the addition of 10% peat to 30.9% and 1.41 respectively; by 20% peat to 42.2% and 1.19; by 30% peat to 57.8% and 0.98. The fireclay brick changed their original absorption of 12.3% and apparent specific gravity of 2.05 to 18.8% and 1.68 with the addition of 10% peat; to 31.1% and 1.35 with 20% peat; to 50.1% and 0.997 with 30% peat. The bricks were of good color and appearance. The data are considered to be favorable indications of the possibility of producing brick with insulating properties from these materials.

SYMPOSIUM ON ROCK AND ROCK PRODUCTS

The Symposium on Rocks and Rock Products which ran concurrently with the Symposium on Illinois Clay and Clay Products on Saturday morning contained some papers of particular interest to the ceramic industry. For example, Mr. Lee S. Trainor, Chief Engineer, National Lime Association, Washington, D. C., in his report on "Trends in the Utilization of Lime and Lime Products", presented among other things the results of recent findings on the influence of the amount of lime in a mortar mix on its water-containing capacity and bonding power.

In his paper on the availability of southern Illinois novaculite as a source material for silica refractories, Professor C. W. Parmelee, presented some interesting and important findings upon the problems attendant upon the burning of such refractories, and upon the relation between certain physical properties of the raw material and the finished product.

The discussion of accelerated weathering tests on concrete by Mr. A. T. Goldbeck, Director of the Bureau of Engineering of the National Crushed Stone Association, in his paper, "The Significance of Accelerated Soundness Tests of Stone and Gravel", emphasized factors in determining the life of construction materials which are of importance to those interested in brick masonry units. Although less closely related to the ceramic industry, the other papers in this symposium were of interest to everyone concerned with the construction industry.

SYMPOSIUM ON COAL

A third symposium running concurrently on Saturday morning was devoted to a contemplation of the future of Illinois coal on the basis of trends in technology and research. This subject was covered in a thoroughgoing manner by a group of specialists including among others, Mr. H. Kreisinger, Research Engineer of the Combustion Engineering Company, New York City, who presented a report on "Furthering the Utilization of Illinois Coal through Proper Equipment Design"; Mr. M. D. Curran, President of the Radiant Fuel Corporation, St. Louis, who spoke on "Illinois Coal as a Source of Gaseous and Liquid Fuel"; and Dr. G. H. Cady of the Illinois State Geological Survey, who read a paper entitled "Possibilities of Improving and Extending the Use of Illinois Coal Through a Study of Its Constituents".

Abstracts of the papers presented at the symposia on Rock and Rock Products and on Coal may be obtained by addressing the Chief, Illinois State Geological Survey, Urbana, Illinois.

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